

## AUTUMNAL FALSE BROODS OF MULTIVOLTINE BUTTERFLIES

AT DONNER PASS, CALIFORNIA

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THE PHENOMENON OF AUTUMNAL "false broods" produced by multivoltine "weedy" butterflies under warm, settled weather conditions has been documented in the northeastern United States (Shapiro 1962, 1967, 1970) and is well known to local collectors in many parts of North America and Europe. It has not been previously recorded at high elevations in mountainous regions, however. Donner Pass, at roughly 7000 feet in the high montane-subalpine Sierra Nevada of north-central California, would seem an unlikely place to look for it. The climate of the Pass has been vividly described by Emmel and Emmel (1963): "Snowmelt occurs in early June while snow flurries can be expected in early September. Sandwiched between nine months of winter—spring, summer and fall in the Donner Pass area must pass rapidly in succession . . . flight or growth seasons are measured in weeks instead of months." The Donner Pass winter has earned its place in the history and folklore of the West. The Donner Party arrived at the Pass on 1 November, 1846 and found the snow already five feet deep. Storm after storm added to that total, raising it to eight feet on the level by 13 December (Stewart, 1959). Neither Emmel and Emmel nor Stewart, however, pointed out that Sierran winters vary enormously in their timing and their severity. Since 1972, I have conducted phenological studies of the butterfly faunas of several localities along a transect paralleling Interstate Highway 80, from sea level at Suisun Bay to 7000 feet in Donner Pass (Shapiro, 1975a). From these studies, it has become apparent that the native fauna of the Pass is mostly univoltine and seasonally conservative, but such is not the case with "weedy" species occurring over a wide altitudinal range and characterized by high vagility and developmental flexibility. Under appropriate autumn conditions, these species will continue to emerge and to breed. It is thus not at

all unusual to find butterfly species which do not hibernate as adults flying in Donner Pass in October and in some years into November.

In 1975, 29 species of butterflies were flying in my Donner study area on 30 September. This rather large number reflected the general lateness of the season due to a cold, wet spring and several cold summer storms. The first snow of the season, an inch, fell on 7 October with eight more inches on 10 October and another eighteen inches by the 12th. However, it warmed rapidly, with afternoon highs in the 60s F and lows near freezing, and by 19 October the snow was gone except on north-facing slopes; five species were flying—*Colias eurytheme* and *Pieris rapae*, both "weedy" non-hibernators, and *Nymphalis californica*, *Vanessa virginiensis*, and *Polygonia zephyrus*, all hibernators. In addition, I noted three species of grasshoppers, various Diptera (Tachinidae, Muscidae, Syrphidae) and Hymenoptera, spiders, four species of mammals, three of birds, and two of lizards; the mid-afternoon temperature was 64°F. After a much colder but snowless interval, it warmed again in early November and I returned on 4 November (temperature again 64°F) and saw one individual each of *C. eurytheme*, *P. rapae*, and *Vanessa carye*.

The 1976 season was very advanced; the snow pack was far below normal and was nearly gone by late April. Most species emerged and disappeared several weeks earlier than in 1975, and by 4 October only 12 species were flying. Continued warm weather produced late emergences of multivoltines and also encouraged altitudinal dispersants, so that 15 species were flying on 15 October with a mid-afternoon temperature of 68°F. On 3 November, in 66° weather, six species were still flying: *Pieris rapae*, *P. protodice*, *Colias eurytheme*, *Plebeius acmon*, and *Pyrgus communis*, all "weedy" non-hibernators, and *Precis coenia*, an immigrant from lower elevations (Shapiro, 1973, 1974). On 10 November, with 60° and variable cloudiness, six species were again recorded: *P. rapae*, *P. protodice*, *C. eurytheme*, *P. acmon*, *P. coenia*, and the hibernator *Vanessa virginiensis*. The butterflies were visiting widely scattered blossoms of *Aster*, *Monardella*, and dandelion (*Taraxacum*). On 14 November a foot of snow fell in the Pass, but immediately thereafter warm, stable conditions returned with daily highs in the 60s and lows in the upper 20s to low 30s. On 20 November, with afternoon temperatures from 63-66°F, snow remained only locally, mostly on north-facing slopes. Five species were recorded: *P. protodice* and *C. eurytheme* (the latter common) and three Nymphalids,

presumably hibernators: *V. virginensis*, *V. carye*, and *Polygonia zephyrus*. Plants recorded in bloom included species of *Potentilla*, *Achillea*, *Aster*, *Solidago*, *Tragopogon*, *Taraxacum*, *Matricaria*, *Cirsium*, *Erodium*, *Sidalcea*, *Wyethia*, *Phacelia*, *Castilleja*, and *Chrysothamnus*. Two species of grasshoppers, Muscid, Syrphid, and Tachinid flies, bumblebees, spiders, and one species of bird were seen, along with black bear tracks in the snow. *Colias* visited *Aster* and *Taraxacum* and were seen flying from 1220 to 1510 hours. Twenty *C. eurytheme* were collected: 12 males, 4 orange females and 4 white females, of which one white was very worn and the other specimens all more or less fresh; one male was soft-winged. The abundance of *C. eurytheme* was probably an accident of seasonal timing; the first spring records (flyups from the east?) were on 14 May, a month earlier than usual; an entire additional generation may have been reared in the Pass in 1976, providing a large reservoir of hatchable autumn pupae. The "rock garden" habitats of characteristic univoltine spring species such as *Incisalia "fotis" windi*, *Callophrys lemberti*, and *Plebeius lupini* were visited but were devoid of butterfly activity.

The probability of successful reproduction by late-emerging multivoltines at Donner Pass is so low that one must assume natural selection would operate against such "mistakes," constantly perfecting diapause-induction systems. That, however, presupposes the existence of resident overwintering populations there. In the case of *P. protodice* and *P. acmon* that supposition is almost certainly false. *C. eurytheme* seems to overwinter only sporadically. Of the "weedy" multivoltines, only *P. rapae* (Shapiro, 1975b) seems to be a permanent resident, but it also has a temperature-photoperiod system for induction of pupal diapause which would limit the amount of wasted fall development. The occurrence of autumnal "false broods" in so difficult an environment as Donner Pass underscores the poor adaptation of "weedy" multivoltine species to cold climates, the ephemeral nature of their populations there, and their contrast with the native montane, subalpine, and alpine fauna, which is "obligately" univoltine under realistic environmental regimes.

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anyone taking a butterfly net to Donner Pass after Labor Day must be crazy, thereby obliging me to do it.

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